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(54) Apparatus for dissolving particulate solids in liquids.

(57) A particulate material (eg calcium hypochlorite granules and dust) in a drum (32) is dissolved in a liquid (eg water) in a tank (10). The liquid is recirculated by a pump (18) via a venturi assembly (22) to produce a vacuum applied via a vacuum tank (26) to a lance (30) inserted in the drum (32). The vacuum transports dust into the venturi assembly (22) to dissolve in the circulating liquid, while granules are transported into the vacuum tank (26) whence they are discharged into the mixing tank (10) by a solenoid valve (36).

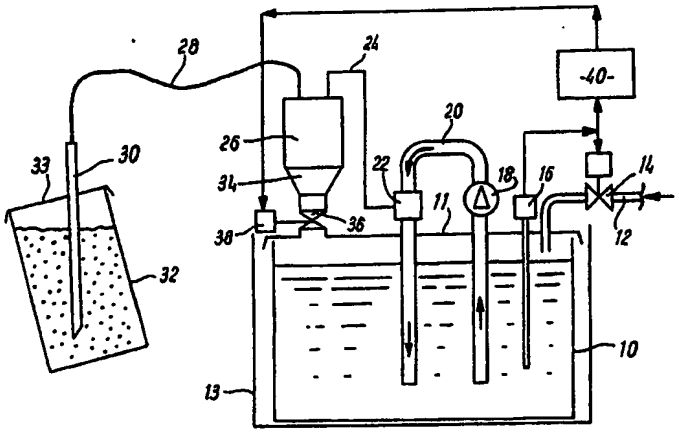

Fig. 1

EP 0 408 360 A2

APPARATUS FOR DISSOLVING PARTICULATE SOLIDS LIQUIDS

This invention relates to an apparatus for dissolving solids in liquids and is particularly, but not exclusively, applicable to making up chlorine solutions for use in swimming pools.

In large, commercially operated swimming pools it is usual to introduce a liquid chlorine solution into the pool water via a metering pump. For economy of transport and storage, chlorine compounds such as calcium hypochlorite are supplied in granule form in drums. Current practice is for the granules to be dissolved in water by hand mixing, and the resulting solution placed in a metering pump reservoir.

This procedure has a number of disadvantages. The mixing requires an operator in attendance, and tends to be carried out by non-technical personnel to a low level of accuracy. The granular material is degraded during transport, resulting in a mixture of granules and fine powder or dust in the drum; hand mixing leaves a residue of dust in the foot of the drum, which dust is difficult for the operator to measure accurately. principal object of the present invention is to overcome or mitigate these problems.

The invention, in one aspect, accordingly provides an apparatus for forming a controlled solution of a particulate solid in a liquid, comprising a mixing tank for holding a known quantity of the liquid, and means for recirculating liquid from the tank through a conduit which contains a venturi assembly, the venturi assembly operating to form a partial vacuum which, in use, transports the solid from a container.

In a preferred embodiment, for use where the solid is in the form of granules mixed with dust, the apparatus includes a vacuum tank interposed between the venturi assembly and the container whereby granules transported from the container are trapped in the vacuum tank while dust passes to be entrained in liquid in the venturi, the vacuum tank being positioned above said mixing tank and being provided with a valve which is openable to empty granules in the vacuum tank into the mixing tank.

Preferably, the apparatus includes means for opening said vacuum tank valve after a predetermined period of operation of the recirculating means.

Preferably also, a metering pump is provided for dispensing solution from the mixing tank.

The apparatus preferably includes container receiving means for holding and vibrating the container, most suitably in an inclined position. In a particularly preferred form, the recirculating means comprises a pump which is mounted on the container receiving means so as to impart vibration thereto.

From another aspect, the invention provides an apparatus for use in emptying particulate material from an open-topped drum, comprising a base inclined to the horizontal and a back inclined to the vertical forming a receptacle for holding the drum in an inclined position, the back mounting a motor which, in operation, imparts vibration to the back and thus to the drum.

Preferably, the motor drives a pump used in emptying the drum.

Preferably the pump circulates liquid via a venturi to create a partial vacuum which is communicated to a hollow lance insertable in particulate material in the drum.

An embodiment of the invention will now be described, by way of example only, with reference to the drawings, in which:

Fig. 1 is a schematic diagram illustrating the operation of an mixing apparatus in accordance with the invention;

Fig. 2 is a detailed cross-section of a venturi assembly used in the apparatus of Fig. 1;

Fig. 3 is a cross-sectional elevation of a vacuum cylinder used in the apparatus;

Figs 4a and 4b are a plan and elevation, respectively, of another part of the apparatus;

Fig. 5 is an elevation, partly in cross-section, of the part of Fig. 4 in use.

Referring to Fig. 1, water is fed to a mixing tank 10 from the mains supply via an inlet pipe 12 and solenoid valve 14. The valve 14 is controlled by a depth sensor 16 to give a predetermined depth (and thus volume) of water in the mixing tank 10.

The water is circulated by a pump 18 through a conduit 20 which includes a venturi assembly 22. Passage of the water through the venturi assembly 22 produces a partial vacuum in line 24 which is connected to a vacuum cylinder 26, which in turn is connected via a flexible hose 28 to a tubular lance 30. The lance 30 has an open lower end which is inserted in a drum 32 containing calcium hypochlorite in the form of granules mixed with a proportion of dust.

The partial vacuum in the cylinder 26 draws a mixture of air, granules and dust through the lance 30 and hose 28 into the cylinder 26. The granules are trapped in the cylinder 26, while the dust passes through with the air to the venturi assembly 22 in which it becomes entrained in, and subsequently dissolves in, the circulating water.

The vacuum cylinder 26 is provided with a hopper-shaped lower part 34 closed by a valve 36

controlled by solenoid 38. In a simple form of the invention, the solenoid 38 is operated by a timing circuit 40 to open the valve 36 a predetermined time after the mixing tank has been filled. At this point the vacuum tank 26 contains a quantity of granules which falls into the mixing tank 10. The pump 18 continues to run, to promote dissolving of the granules, but the open valve 36 prevents vacuum passing to the hose 28 to transport further chloride. The vacuum tank 26 may optionally include a weight or depth sensor to actuate the solenoid 38 if the tank 26 is overfilled with granules before the timing circuit 40 operates.

Thus, with the present embodiment an operator simply has to insert the lance 30 in the drum and switch on the apparatus. At a given time later, the mixing tank 10 contains a known quantity of chlorine solution. The strength of the solution is determined by the vacuum, which in turn is a function of the pump rate and the venturi dimensions, and the time the valve 36 is closed, and is much more accurate than manual mixing.

The solution thus produced may be used to supply a conventional metering pump for application to a swimming pool. Alternatively, since the tank 10 contains a known quantity of the solution at a known concentration, these contents could be added to a swimming pool by gravity or non-metering pump on a regular basis, say once per day.

It would also be possible to operate the apparatus continuously, with the tank 10 connected to supply a metering pump directly. In this case, the outlet from the tank to the metering pump would be provided with a filter to prevent the discharge of undissolved granules.

In the interests of safety, the drum 32 is closed in use by a cover 33 which is apertured for the lance 30, while the mixing tank 10 is closed by a cover 11 and enclosed within a liquid-tight bund wall 13.

Turning to Fig. 2, the venturi assembly 22 comprises a water inlet connector 42, injector nozzle 44, venturi tube 46, and water outlet connector 48. A tubular spacer 50 and tee piece 52 maintain an entrainment space between the injector nozzle 44 and venturi tube 46, the tee piece 52 including a branch 54 for connection to the vacuum line 24.

As seen in Fig. 3, the vacuum cylinder 26 has a unitary body with a cylindrical main portion 56, and hopper shaped lower part 34 terminating in a boss 58 which is externally threaded for connection of the valve 36 (Fig. 1). The top of the cylinder 26 is closed by a bolted cover 60 formed with connectors 62, 64 for the vacuum line 24 and hose 28.

Turning now to Figs 4 and 5, a further aspect of the present invention will be described. It is desirable that the apparatus, once set in action, can function without operator intervention, and that the lance 30 removes the contents of the drum 32 entirely and at a uniform rate.

A drum holder and agitator comprises a bottom plate 66 connected to a top plate 68 by four parallel rods 70 so as to hold the drum 32 in an inclined position. The water circulating pump 18 is mounted on the top plate 68, whereby operation of the pump 18 causes vibration of the rods 70 and thus of the drum 32. To enhance this action, it may be desirable to mount the pump 18 on the top plate 68 via soft rubber mountings and/or to provide an eccentric rotating weight on the pump. It is also necessary that the drum holder is not too rigid; it is presently preferred that the top and bottom plates 66, 68 are of 5mm mild steel plate and the rods 70 of 10mm mild steel.

The arrangement ensures, as indicated in Fig. 5 that the final contents of the drum migrate into a lower corner. It has been found that a simple open-ended tubular lance 30 can be pushed into a full drum and with the arrangement shown will also migrate as the drum empties until its open end rests in the lower corner.

Modifications and improvements may be incorporated without departing from the scope of the invention

Claims

1. Apparatus for forming a controlled solution of a particulate solid in a liquid, comprising a mixing tank for holding a known quantity of the liquid, and means for recirculating liquid from the tank through a conduit which contains a venturi assembly, the venturi assembly operating to form a partial vacuum which, in use, transports the solid from a container.

2. Apparatus according to Claim 1, for use where the solid is in the form of granules mixed with dust, the apparatus including a vacuum tank interposed between the venturi assembly and the container whereby granules transported from the container are trapped in the vacuum tank while dust passes to be entrained in liquid in the venturi, the vacuum tank being positioned above said mixing tank and being provided with a valve which is openable to empty granules in the vacuum tank into the mixing tank.

3. Apparatus according to Claim 2, including means for opening said vacuum tank valve after a predetermined period of operation of the recirculating means.

4. Apparatus according to any preceding Claim, including a metering pump for dispensing solution from the mixing tank.

5. Apparatus according to any preceding Claim, in

which the solid is taken from a removable drum, the apparatus including a lance, for insertion in the drum, connected to the venturi assembly via a flexible hose.

6. Apparatus according to any preceding Claim, including means for holding and vibrating the container.

7. Apparatus according to Claim 6, in which the recirculating means comprises a pump which is mounted on the container receiving means so as to import vibration thereto.

8. Apparatus for use in emptying particulate material from a drum, comprising a base inclined to the vertical forming a receptacle for holding the drum in an inclined position, the back mounting a motor which, in operation, imparts vibration to the back and thus to the drum.

9. Apparatus according to Claim 8, in which the motor drives a pump used in emptying the drum.

10. Apparatus according to Claim 9, in which the pump circulates liquid via a venturi to create a partial vacuum which is communicated to a hollow lance insertable in particulate material in the drum.

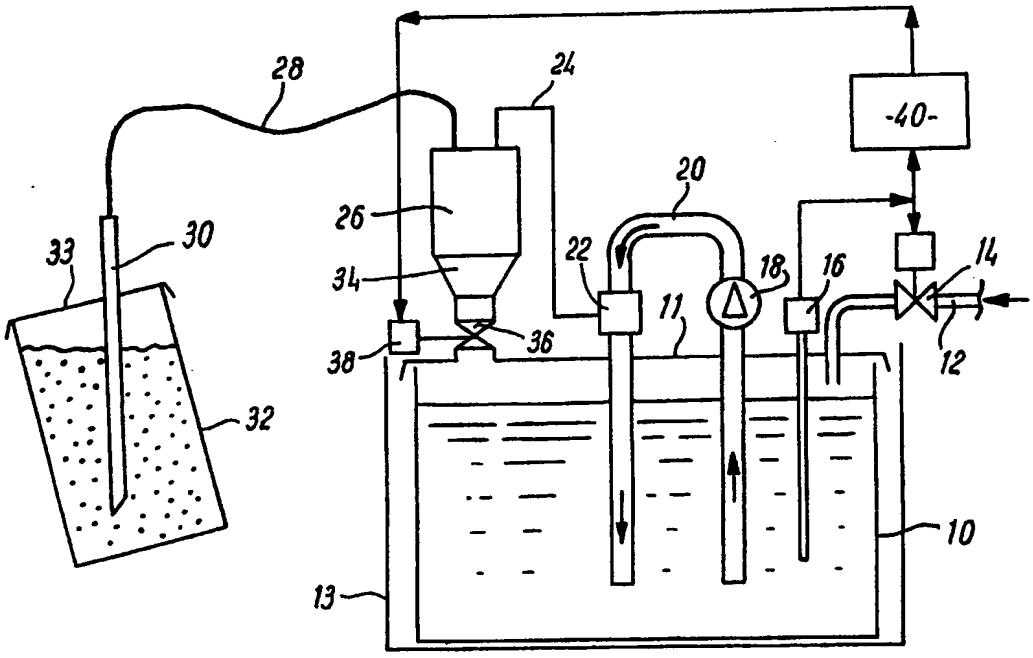

FIG. 1

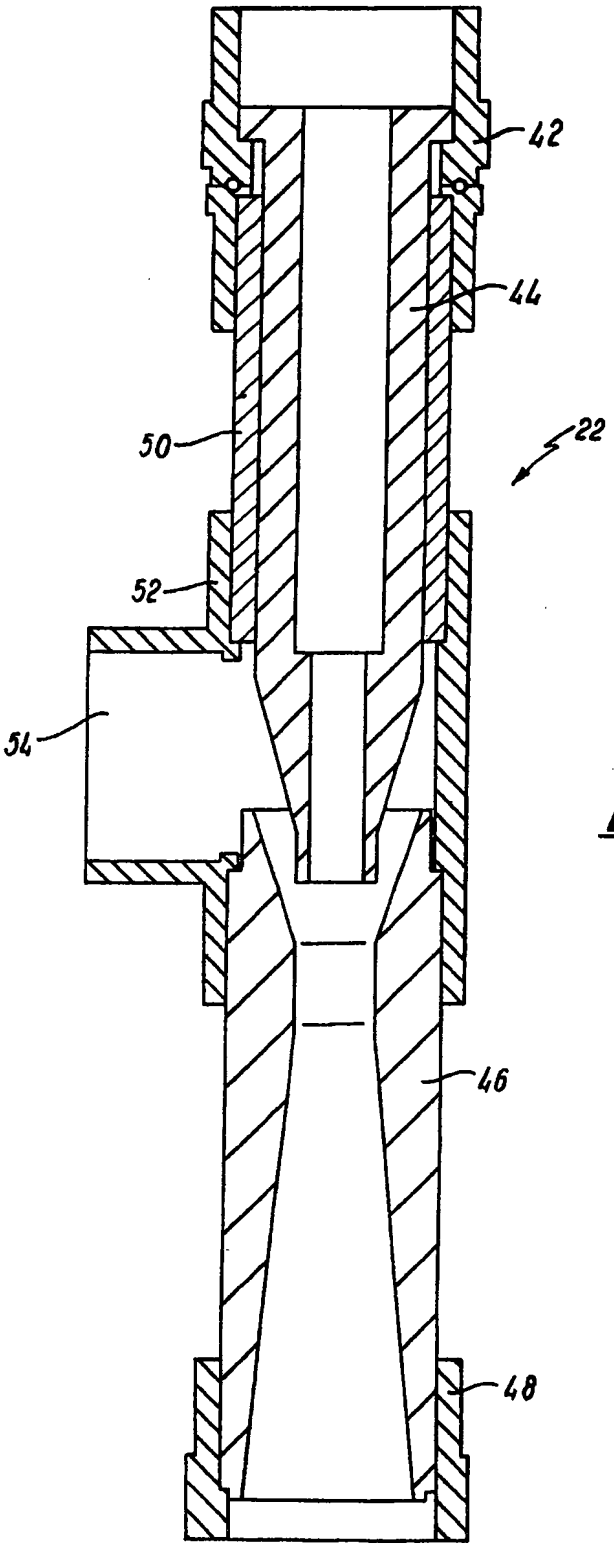

FIG.2

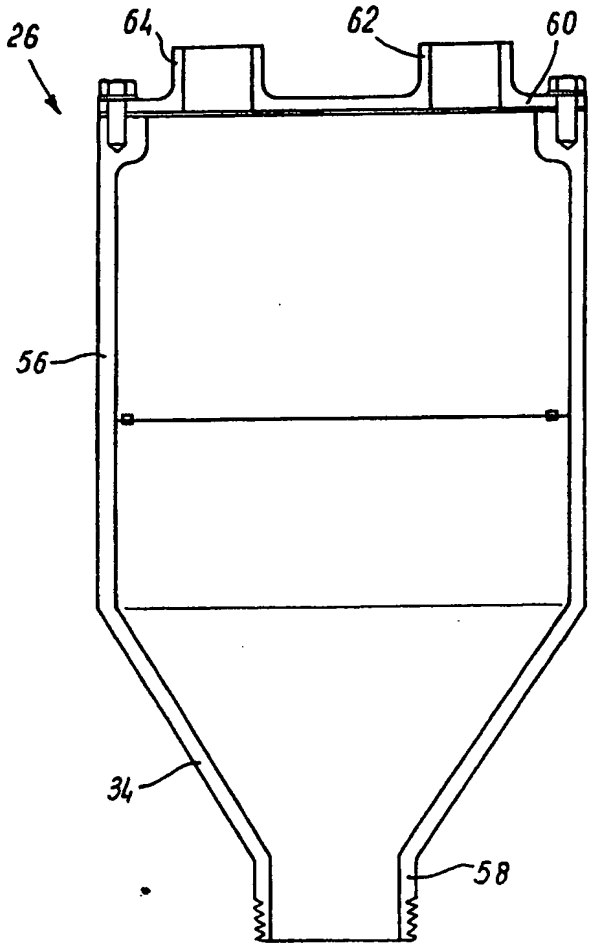

FIG. 3

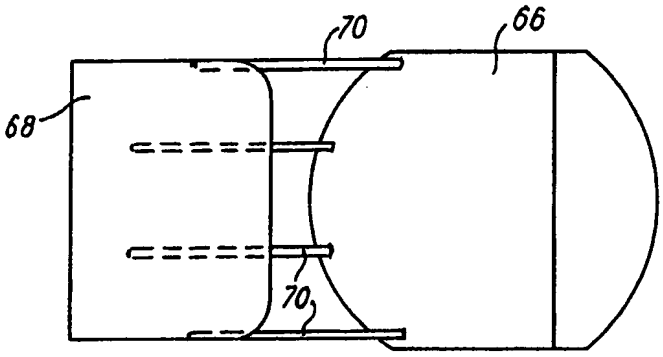

FIG. 4a

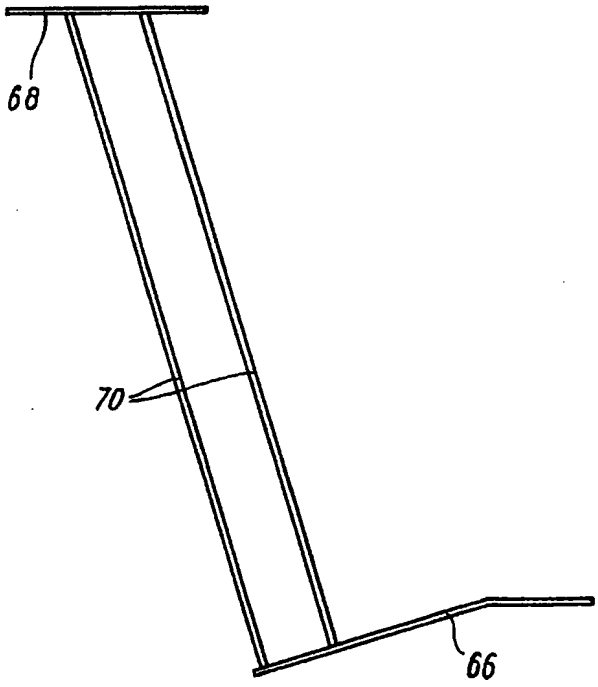

FIG. 4b

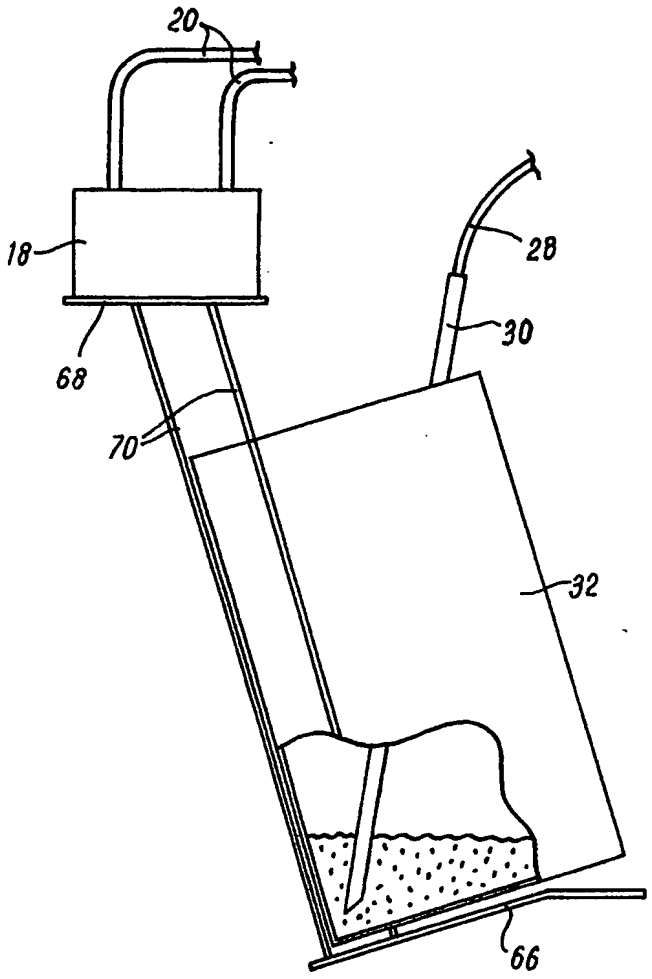

FIG. 5